Technical Publications

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Centricity Universal Viewer Zero Footprint (ZFP) DICOM CONFORMANCE STATEMENT

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REVISION HISTORY

Revision	Date	Author	Description
1	7-May-2015	Shilpa Venkataraman	Initial version for Centricity Universal Viewer Zero Footprint v6.0.
2	16-June-2015	Rugma Ramesh	Updated version for Centricity Universal Viewer Zero Footprint v6.0-SP1. Added SOPs for Multi-Frame Grayscale Byte SC Image, Multi-Frame True Color SC Image, NM Image (Retired) and RT image.
3	29-June-2015	Rugma Ramesh	Updated version for Centricity Universal Viewer Zero Footprint v6.0-SP1. Updated all existing SOP Classes and SOP Class UIDs
4	22-Mar-2016	Rugma Ramesh	Updated version for Centricity Universal Viewer Zero Footprint v6.0-SP3. • Updated the SOP Class UID for Ultrasound Multi-frame Image Storage. • Added Grayscale Softcopy Presentation State Storage SOP Class.
5	02-March-2017	Igor Bendersky	Updated version for Centricity Universal Viewer Zero Footprint v6.0-SP6. • Updated document to indicate that ZFP now supports GE HealthCloud Object Store deployments. • Added application data flow diagrams (sections 2.2.1-2.2.3). • Added addition information for sequencing of real-works activities (section 2.2.3.1 and 2.2.3.2). • Added window/level computation and pixel spacing handling information (section 2.3). • Indicated that ZFP supports other languages in addition to English (section 2.4).
6	09-February-2019	Matt Adler	Updated version for Centricity Universal Viewer Zero Footprint v6.0-SP10. • 12-Lead ECG Waveform Storage (for GE Only) (Section 2.3.3)

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CONFORMANCE STATEMENT OVERVIEW

The Universal Viewer ZFP is a viewing application of DICOM objects that are stored on the Centricity Enterprise Archive or the Centricity PACS server. All of the networking, database, and other services are provided by the Centricity Enterprise Archive or the Centricity PACS server. This conformance claim refers to the conformance claim for the Centricity Enterprise Archive or the Centricity PACS server for all such services. The Universal Viewer ZFP accesses rendered DICOM Objects as a client user of WADO-URI service. Table 0.1 provides an overview of the DICOM objects can be displayed by ZFP.

Table 0.1 – Displayable SOP Classes

SOP Classes	SOP Class UID
12-Lead ECG Waveform Storage (for GE MUSE Only)	1.2.840.10008.5.1.4.1.1.9.1.1
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-Frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography X-Ray Image Storage – for Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography X-Ray Image Storage – for Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
Ophthalmic Tomography Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.4

SOP Classes	SOP Class UID
12-Lead ECG Waveform Storage (for GE MUSE Only)	1.2.840.10008.5.1.4.1.1.9.1.1
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
NM Image (Retired)	1.2.840.10008.5.1.4.1.1.5
RT Image	1.2.840.10008.5.1.4.1.1.481.1

TABLE OF CONTENTS

1. INTRODUCTION 7

1.1 Overview 7

1.2 Overall DICOM Conformance Statement Document Structure 8

1.3 Intended Audience 9

1.4 Scope and Field of Application 9

1.5 Important Remarks 9

1.6 References 10

1.7 Definitions 10

1.8 Symbols and Abbreviations 12

2. NETWORK CONFORMANCE STATEMENT 15

2.1 Introduction 15

2.2 Implementation Model 16
2.2.1 Application Data Flow Diagram 16
2.2.2 Real-World Activity – Viewing a DICOM Object 19
2.2.3 Sequencing of Real-World Activities 19

2.3 Extensions / Specializations / Privatizations 19
2.3.1 Window/Level Computation 19
2.3.2 Pixel Spacing Handling 20
2.3.3 Electrocardiogram Support 21

2.4 Support of Extended Character Sets 23

2.5 Photometric Interpretation Support 24

2.6 Security Profiles 24

2.7 WADO-URI Service 24
2.7.1 WADO-URI Specification 24

1. INTRODUCTION

1.1 OVERVIEW

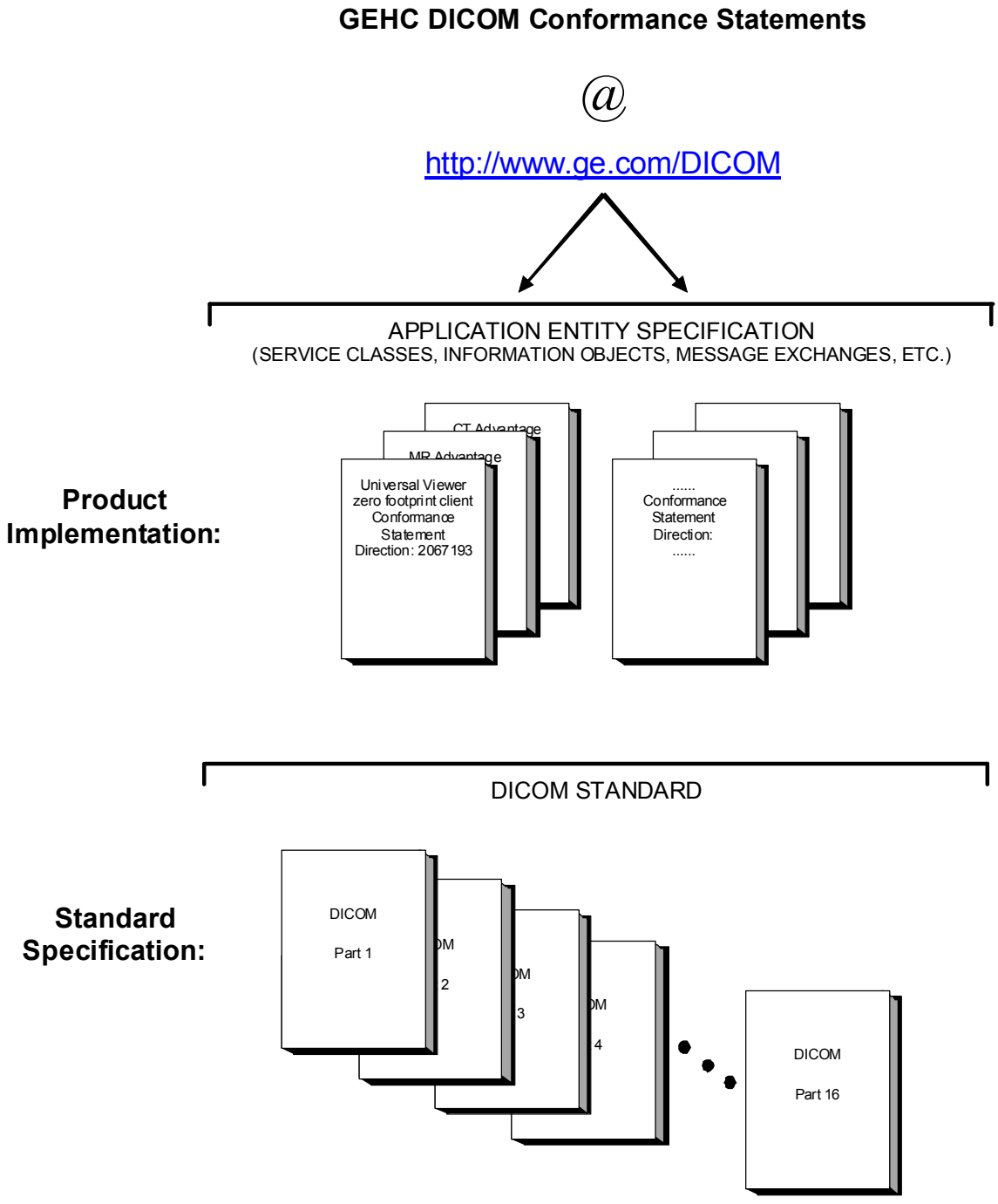
This DICOM Conformance Statement is divided into Sections as described below:

Section 1 (Introduction), which describes the overall structure, intent, and references for this Conformance Statement

Section 2 (Network Conformance Statement), which specifies the GEHC equipment compliance to the DICOM requirements for the implementation of Networking features.

1.2 OVERALL DICOM CONFORMANCE STATEMENT DOCUMENT STRUCTURE

The Documentation Structure of the GEHC DICOM Conformance Statements is shown in the Illustration below.



This document specifies the DICOM implementation. It is entitled:

Universal Viewer ZFP

This DICOM Conformance Statement documents the DICOM Conformance Statement and Technical Specification required to interoperate with the GEHC network interface.

The GEHC Conformance Statement, contained in this document, also specifies the Lower Layer communications which it supports (e.g., TCP/IP). However, the Technical Specifications are defined in the DICOM Part 8 standard.

For more information regarding DICOM, copies of the Standard may be obtained on the Internet at http://medical.nema.org. Comments on the Standard may be addressed to:

DICOM Secretariat
NEMA
1300 N. 17th Street, Suite 1752
Rosslyn, VA 22209
USA
Phone: +1.703.841.3200

1.3 INTENDED AUDIENCE

The reader of this document is concerned with software design and/or system integration issues. It is assumed that the reader of this document is familiar with the DICOM Standard and with the terminology and concepts which are used in that Standard.

1.4 SCOPE AND FIELD OF APPLICATION

It is the intent of this document to provide an unambiguous specification for GEHC implementations. This specification, called a Conformance Statement, includes a DICOM Conformance Statement and is necessary to ensure proper processing and interpretation of GEHC medical data exchanged using DICOM. The GEHC Conformance Statements are available to the public.

The reader of this DICOM Conformance Statement should be aware that different GEHC devices are capable of using different Information Object Definitions. For example, a GEHC CT Scanner may send images using the CT Information Object, MR Information Object, Secondary Capture Object, etc.

Included in this DICOM Conformance Statement are the Module Definitions which define all data elements used by this GEHC implementation. If the user encounters unspecified private data elements while parsing a GEHC Data Set, the user is well advised to ignore those data elements (per the DICOM standard). Unspecified private data element information is subject to change without notice. If, however, the device is acting as a "full fidelity storage device", it should retain and re-transmit all of the private data elements which are sent by GEHC devices.

1.5 IMPORTANT REMARKS

The use of these DICOM Conformance Statements, in conjunction with the DICOM Standards, is intended to facilitate communication with GE imaging equipment. However, **by itself, it is not sufficient to ensure that inter-operation will be successful**. The **user (or user's agent)** needs to proceed with caution and address at least four issues:

- **Integration** - The integration of any device into an overall system of interconnected devices goes beyond the scope of standards (DICOM v3.0), and of this introduction and associated DICOM Conformance Statements when interoperability with non-GE equipment is desired. The responsibility to analyze the applications requirements and to design a solution that integrates GE imaging equipment with non–GE

systems is the **user's** responsibility and should not be underestimated. The **user** is strongly advised to ensure that such an integration analysis is correctly performed.

- **Validation** - Testing the complete range of possible interactions between any GE device and non–GE devices, before the connection is declared operational, should not be overlooked. Therefore, the **user** should ensure that any non–GE provider accepts full responsibility for all validation required for their connection with GE devices. This includes the accuracy of the image data once it has crossed the interface between the GE imaging equipment and the non–GE device and the stability of the image data for the intended applications.

  Such a validation is required before any clinical use (diagnosis and/or treatment) is performed. It applies when images acquired on GE imaging equipment are processed/displayed on a non-GE device, as well as when images acquired on non-GE equipment is processed/displayed on a GE console or workstation.

- **Future Evolution** - GE understands that the DICOM Standard will evolve to meet the user's growing requirements. GE is actively involved in the development of the DICOM Standard. DICOM will incorporate new features and technologies and GE may follow the evolution of the Standard. The GEHC protocol is based on DICOM as specified in each DICOM Conformance Statement. Evolution of the Standard may require changes to devices which have implemented DICOM. **In addition, GE reserves the right to discontinue or make changes to the support of communications features (on its products) described by these DICOM Conformance Statements**. The **user** should ensure that any non–GE provider, which connects with GE devices, also plans for the future evolution of the DICOM Standard. Failure to do so will likely result in the loss of function and/or connectivity as the DICOM Standard changes and GE Products are enhanced to support these changes.

- **Interaction** - It is the sole responsibility of the **non–GE provider** to ensure that communication with the interfaced equipment does not cause degradation of GE imaging equipment performance and/or function.

1.6 REFERENCES

1. Digital Imaging and Communications in Medicine (DICOM) Standards, available free at http://medical.nema.org/

2. Centricity Enterprise Archive V4.0 DICOM CONFORMANCE STATEMENT, DOC0708777

3. Centricity PACS Version 4.0 DICOM CONFORMANCE STATEMENT, DOC1145900

1.7 DEFINITIONS

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax – the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

Application Entity (AE) – an end point of a DICOM information exchange, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title – the externally known name of an *Application Entity*, used to identify a DICOM application to other DICOM applications on the network.

Application Context – the specification of the type of communication used between *Application Entities*. Example: DICOM network protocol.

Association – a network communication channel set up between *Application Entities*.

Attribute – a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (Sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD) – the specified set of *Attributes* that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The *Attributes* may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Joint Photographic Experts Group (JPEG) – a set of standardized image compression techniques, available for use by DICOM applications.

Media Application Profile – the specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs)

Module – a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation – first phase of *Association* establishment that allows *Application Entities* to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context – the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

Protocol Data Unit (PDU) – a packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Security Profile – a set of mechanisms, such as encryption, user authentication, or digital signatures, used by an *Application Entity* to ensure confidentiality, integrity, and/or availability of exchanged DICOM data

Service Class Provider (SCP) – role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

Service Class User (SCU) – role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)

Service/Object Pair (SOP) Class – the specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance – an information object; a specific occurrence of information exchanged in a *SOP Class*. Examples: a specific x-ray image.

Tag – a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the "group" and the "element". If the "group" number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element]

Transfer Syntax – the encoding used for exchange of DICOM information objects and messages. Examples: *JPEG* compressed (images), little endian explicit value representation.

Unique Identifier (UID) – a globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR) – the format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

1.8 SYMBOLS AND ABBREVIATIONS

AE	Application Entity
AET	Application Entity Title
CAD	Computer Aided Detection
CDA	Clinical Document Architecture
CD-R	Compact Disk Recordable
CSE	Customer Service Engineer
CR	Computed Radiography
CT	Computed Tomography
DHCP	Dynamic Host Configuration Protocol
DICOM	Digital Imaging and Communications in Medicine
DIT	Directory Information Tree (LDAP)
DN	Distinguished Name (LDAP)
DNS	Domain Name System
DX	Digital X-ray
ECG	Electrocardiogram
FSC	File-Set Creator
FSU	File-Set Updater
FSR	File-Set Reader
GSDF	Grayscale Standard Display Function
GSPS	Grayscale Softcopy Presentation State
HIS	Hospital Information System
HL7	Health Level 7 Standard
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
IPv4	Internet Protocol version 4

IPv6	Internet Protocol version 6
ISO	International Organization for Standards
IO	Intra-oral X-ray
JPEG	Joint Photographic Experts Group
LDAP	Lightweight Directory Access Protocol
LDIF	LDAP Data Interchange Format
LUT	Look-up Table
MAR	Medication Administration Record
MPEG	Moving Picture Experts Group
MG	Mammography (X-ray)
MPPS	Modality Performed Procedure Step
MR	Magnetic Resonance Imaging
MSPS	Modality Scheduled Procedure Step
MTU	Maximum Transmission Unit (IP)
MWL	Modality Worklist
NM	Nuclear Medicine
NTP	Network Time Protocol
O	Optional (Key Attribute)
OCT	Ophthalmic Tomography
OP	Ophthalmic Photography
OSI	Open Systems Interconnection
PACS	Picture Archiving and Communication System
PET	Positron Emission Tomography
PDF	Portable Document Format
PDU	Protocol Data Unit
R	Required (Key Attribute)
RDN	Relative Distinguished Name (LDAP)
RF	Radiofluoroscopy
RIS	Radiology Information System

RT	Radiotherapy
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
SPS	Scheduled Procedure Step
SR	Structured Reporting
TCP/IP	Transmission Control Protocol/Internet Protocol
U	Unique (Key Attribute)
UL	Upper Layer
US	Ultrasound
VL	Visible Light
VR	Value Representation
XA	X-ray Angiography

2. NETWORK CONFORMANCE STATEMENT

2.1 INTRODUCTION

This section of the DICOM Conformance Statement specifies the Universal Viewer ZFP compliance to DICOM requirements for **Networking** features.

The Universal Viewer ZFP is a viewing application. The Universal Viewer ZFP does not directly communicate using DICOM network protocols with external equipment however it does read DICOM objects from the Centricity Enterprise Archive or the Centricity PACS server. This section will define the DICOM objects supported by the application and any limitations dictated by DICOM defined content within the objects.

Table 2-1 lists the DICOM objects supported by the Universal Viewer ZFP for viewing purposes. Although the host server may support additional SOP Classes, the Universal Viewer ZFP is only able to interpret objects that meet the conditions in the table below.

Table 2-1 – Displayable SOP Classes

SOP Classes	SOP Class UID
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-Frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography X-Ray Image Storage – for Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography X-Ray Image Storage – for Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2

SOP Classes	SOP Class UID
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1
Ophthalmic Tomography Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.4
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
NM Image (Retired)	1.2.840.10008.5.1.4.1.1.5
RT Image	1.2.840.10008.5.1.4.1.1.481.1
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1

2.2 IMPLEMENTATION MODEL

2.2.1 Application Data Flow Diagram

2.2.1.1 Storage AE For SOP Instance Display

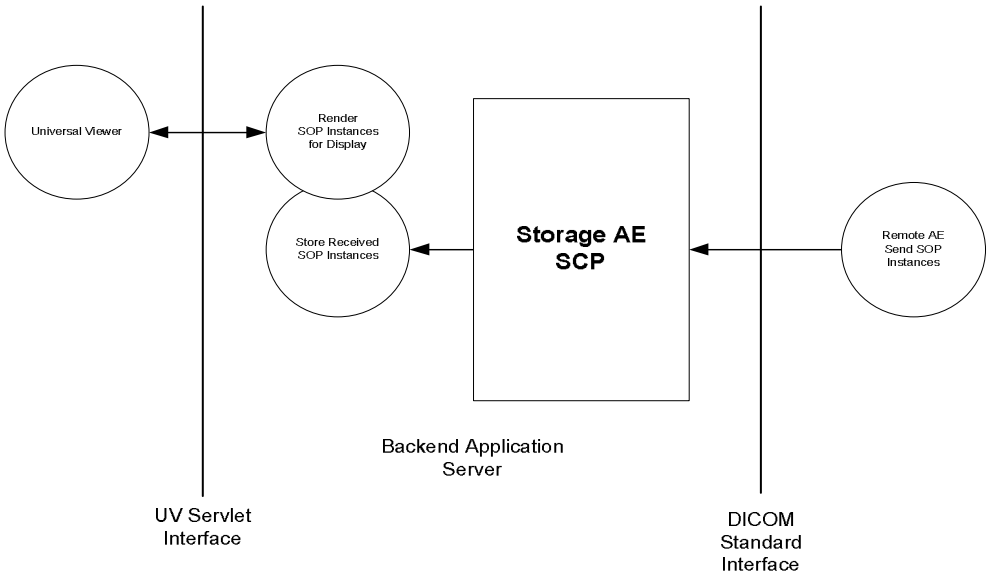
The Storage AE implements the SCP roles of the DICOM Storage SOP classes for storing DICOM Storage SOP instances.

Note: The Storage AE services are provided by their configured backend application server. As such, Universal Viewer ZFP does not directly handle DICOM network features related to Storage AE. It communicates to the backend application server using an internal service API.

Centricity PACS, Centricity PACS-IW, and Centricity Enterprise Archive backend application servers support a conceptual Storage AE that may be named differently in their conformance statements.

Please refer to the DICOM Conformance Statement of the appropriate backend application server for more information.

FIGURE 2-1
DATA FLOW DIAGRAM OF STORAGE AE FOR SOP INSTANCE DISPLAY



2.2.1.2 Send AE for SOP Instance Transfer to Remote AE

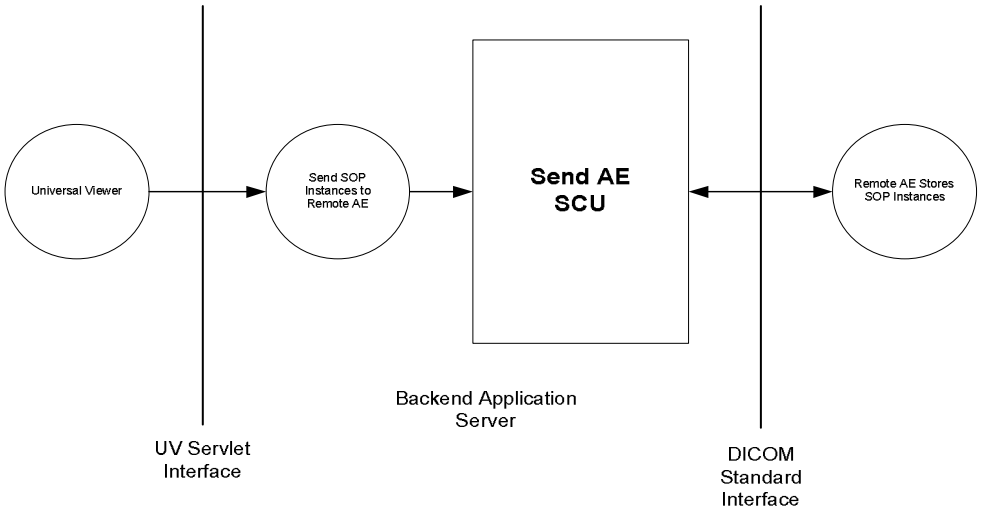
The Send AE implements the SCU roles of the DICOM Storage SOP classes for sending DICOM Storage SOP instances to a remote AE.

Note: The Send AE services are provided by their configured backend application server. As such, Universal Viewer ZFP does not directly initiate DICOM network features related to Send AE. It communicates to the backend application server using an internal service API.

At this time, only the Centricity PACS and Centricity Enterprise Archive backend application servers provide the Send AE service.

Please refer to the Centricity PACS DICOM Conformance Statement for more information.

FIGURE 2-2
DATA FLOW DIAGRAM OF SEND AE FUNCTIONALITY



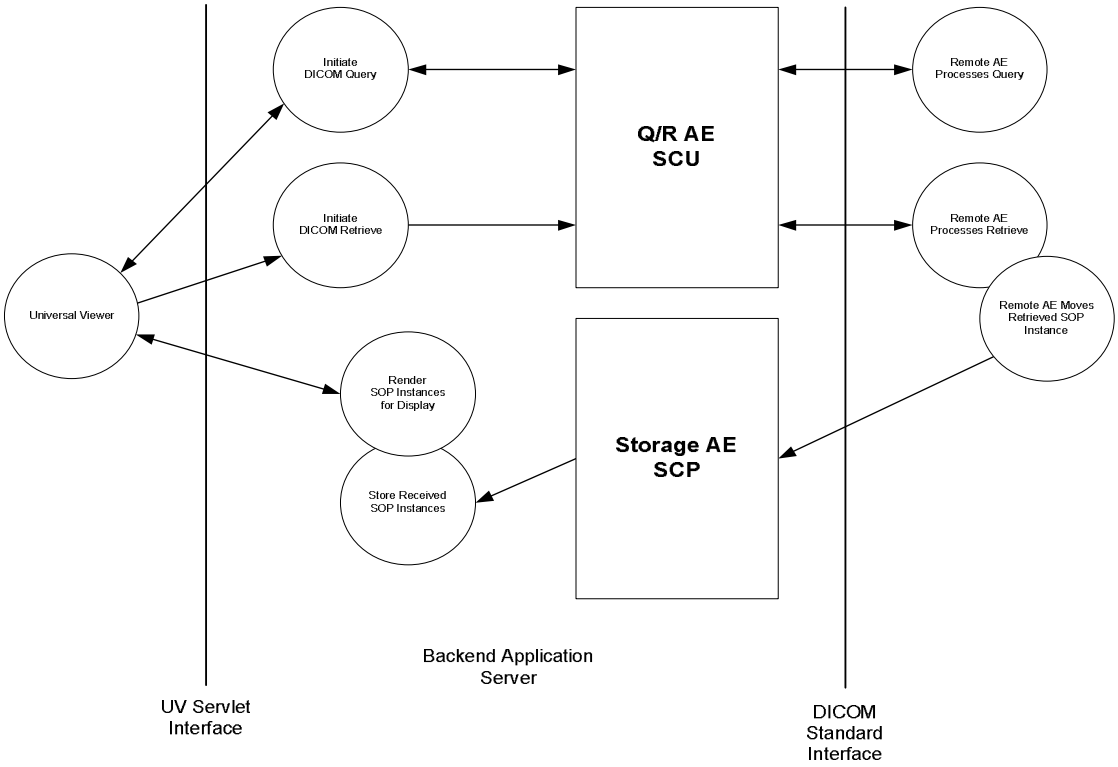
2.2.1.3 Query/Retrieve AE Functionality

Note: The Query/Retrieve AE services are provided by the configured backend application server. Universal Viewer ZFP communicates to the backend application server using a host service API and thus does not directly initiate DICOM network features related to Query/Retrieve.

Centricity PACS, Centricity PACS-IW, and Centricity Enterprise Archive backend application servers support Query/Retrieve AE.

Please refer to the DICOM Conformance Statement of the appropriate backend application server for more information.

FIGURE 2-3
DATA FLOW DIAGRAM OF QUERY/RETRIEVE AE FUNCTIONALITY



2.2.2 Real-World Activity – Viewing a DICOM Object

The user can load any supported DICOM object into the Universal Viewer ZFP for viewing.

2.2.3 Sequencing of Real-World Activities

2.2.3.1 Real-World Activity – Viewing a DICOM Object

The user may load any supported DICOM object into the Universal Viewer ZFP for viewing.

2.2.3.2 Real World Activity – Creation of Grayscale Presentation States

The user may create Grayscale Presentation States in the Universal Viewer ZFP and save the results in the configured backend server using direct access services.

2.3 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

2.3.1 Window/Level Computation

It is expected that optimal Window Center and Width values are specified in the DICOM Object Objects if they have greater than 8 bits of data stored per sample. If optimal Window Center and Width values are not provided, then Universal Viewer ZFP is capable of estimating values using histogram analysis.

2.3.2 Pixel Spacing Handling

The Universal Viewer ZFP supports use of the pixel spacing / Imager Pixel Spacing attributes described below for different types of images including secondary capture to calculate and display geometric measurement results in images. The user is strongly advised to verify the logic below is compatible with the pixel spacing / Imager Pixel Spacing / ERMF information provided by the modalities used at their site.

DICOM Attributes	Attributes existed in Header		Geometric Measurement for CR / DX image	Geometric Measurement for XA / RF / MG image
	YES	NO		
Pixel Spacing (0028,0030)	X			
Imager Pixel Spacing (0018,1164)		X		
ERMF (0018,1114)		X	in unit (Cm)	in unit (Cm)
Pixel Spacing (0028,0030)		X		
Imager Pixel Spacing (0018,1164)	X			
ERMF (0018,1114)		X	in unit (Cm)	pixels
Pixel Spacing (0028,0030)	X			
Imager Pixel Spacing (0018,1164)	X			
ERMF (0018,1114)		X	in unit (Cm)	if PS = IPS, then pixels If PS ≠ IPS, then in unit (Cm)
Pixel Spacing (0028,0030)		X		
Imager Pixel Spacing (0018,1164)		X		
ERMF (0018,1114)		X	pixels	pixels
Pixel Spacing (0028,0030)	X			
Imager Pixel Spacing (0018,1164)		X		
ERMF (0018,1114)	X		in unit (Cm)	in unit (Cm)
Pixel Spacing (0028,0030)		X		
Imager Pixel Spacing (0018,1164)	X			
ERMF (0018,1114)	X		pixels	pixels
Pixel Spacing (0028,0030)	X		if PS = IPS, then pixels If PS ≠ IPS, then in unit (Cm)	if PS = IPS, then pixels If PS ≠ IPS, then in unit (Cm)
Imager Pixel Spacing (0018,1164)	X			

2.3.3 Electrocardiogram Support

The Universal Viewer ZFP supports use Electrocardiogram from GE Modalities and their attributes with the exception specific validations that are included to ensure accurate waveform calculations.

2.3.3.1 Waveform display

ZFP will support ECG waveform display if the DICOM file confirms to the below table. Any value other than the expected values will result in invalidating the DICOM file and user will be presented with an error message.

Attribute Name	Tag	Type	Expected Value
Waveform Originality	(003A, 0004)	1	ORIGINAL (Only one sequence should be present) DERIVED (Only one sequence should be present)
Number of Waveform Channels	(003A, 0005)	1	<=13 (including all standard 12 leads + "-aVR")
>>Channel Baseline	(003A, 0213)	1C	0
>>Channel Time Skew	(003A, 0214)	1C	0
>>Channel Sample Skew	(003A, 0215)	1C	0
>>Channel Offset	(003A, 0218)	3	0
Channel Sensitivity	(003A, 0210)	1C	Has to be present with a Non zero value. Although DICOM says its optional, but ZFP mandates it.
Channel Sensitivity Units Sequence	(003A, 0211)	1C	Millivolt or Microvolts DICOM says its optional, but ZFP mandates it.
Manufacturer	(0008, 0070)	2	"GE Healthcare" or "GE Medical Systems"
Waveform Bits Stored	(003A,021A)	1	16
Waveform Bits Allocated	(5400,1004)	1	16

Waveform Sample Interpretation	(5400,1006)	1	SS
Waveform Padding Value	(5400,100A)	1C	0

2.3.3.2 Coding Scheme Designator validations

ZFP will validate and parse a DICOM file and if the following Coding Scheme designators are adhered to, otherwise an error will be thrown to user:

Attribute Name	Tag	Supported coding scheme designator
Channel Sensitivity Unit sequence	(003A, 0211)	UCUM
Channel Source Sequence	(003A, 0208)	SCPECG

2.3.3.3 Pacemaker Annotation

Per DICOM. Pacemaker annotations like other annotations can be linked to specific channels/leads. ZFP does not accept pace maker annotation with any lead information. It just accepts a set of points on the 10 second time scale (in terms of TimeValue (ms) or SamplePosition).

ZFP will check if the pace maker information applies to all the channels or not. If not, throw an exception.

ZFP will identify if an annotation is pace maker annotation or not based on code value 5.10.1.2 and scheme as SCPECG.

Code Value	SH	8	5.10.1.2
Coding Scheme Design	SH	8	SCPECG
Coding Scheme Version	SH	4	1.3
Code Meaning	LO	16	Pacemaker Spike

The pacemaker information will be read when the below conditions are satisfied. In case it is not satisfied, no error will be thrown but just the pace maker information will not be displayed on the waveform

Attribute Name	**Tag**	**Expected Value**
Waveform Originality	(0040, A0B0)	1\0 (Applies to all the channels within the multiplex group)

Temporal Range Type	(0040, A130)	POINT
Referenced Sample Positions	(0040, A132)	"TimeValue" (GE modality specific) – NonDICOM, or "SamplePosition"

2.4 SUPPORT OF EXTENDED CHARACTER SETS

The Universal Viewer ZFP is configurable with a single single-byte or multi-byte extended character set, depending on the language selected during installation of the system. The following extended Character Sets are supported:

TABLE 2.3 Extended Character Set Support

Encoding	DICOM Term in Specific Character Set (0008,0005)	Supported Languages
ASCII	Attribute is not present or ISO IR-6	English
Latin-1	ISO IR-100	English, Faeroese, Finnish, French, German, Italian, Portuguese, Spanish,
Latin-2	ISO IR-101	English, Polish, Hungarian.
Latin/Cyrillic	ISO IR-144	English, Russian
Latin/Hebrew	ISO IR-138	English, Hebrew
JIS X 0201	ISO IR-13	English, Japanese (in Katakana alphabet). Limited use as Japanese encoding does not support hieroglyphic alphabet
JIS X 0208	ISO 2022 IR-87	English, Japanese Kanji (hieroglyphic) – uses escape sequences to switch between ASCII (single byte) and Japanese (two-byte per character)
KS X 1001	ISO 2022 IR-149	English, Korean – uses escape sequences to switch between ASCII (single byte) and Korean (two-byte per character)
GB18030	GB18030	English, Simplified Chinese

While the backend servers may support additional character sets, the Universal Viewer ZFP will display in the user interface only characters specified as within ISO IR-6 (ASCII) or the configured extended character set.

The user interface will allow the user to enter characters from the console keyboard that are within ASCII or the configured extended character set.

Whether character sets are displayed correctly depends on the characteristics of the backend system, the validity of the DICOM header contents, and the presence of appropriate fonts on the client system.

2.5 PHOTOMETRIC INTERPRETATION SUPPORT

While the backend server may support additional values for photometric interpretation, the Universal Viewer ZFP will only display SOP instances that contain one of the following values for Photometric Interpretation (0028,0004):

- MONOCHROME1
- MONOCHROME2
- RGB

2.6 SECURITY PROFILES

The product does not conform to any defined DICOM Security Profiles.

It is assumed that the product is used within a secured environment. It is assumed that a secured environment includes at a minimum:

1. Firewall or router protections to ensure that only approved external hosts have network access to the product.
2. Firewall or router protections to ensure that the product only has network access to approved external hosts and services.
3. Any communications with external hosts and services outside the locally secured environment use appropriate secure network channels (such as a Virtual Private Network (VPN))

2.7 WADO-URI SERVICE

This Universal Viewer ZFP Patient Timeline product implements the WADO-URI services as a client user for access to rendered DICOM SOP Instances that are stored on a server supporting DICOM WADO-URI service.

TABLE 2.4 Network Services

Network Service	User of Service (Client)	Provider of Service (Server)
WADO - URI - Retrieve Rendered Imaging Document	Yes	No

2.7.1 WADO-URI Specification

TABLE 2.5 WADO-URI Retrieve Imaging Document Specification

Parameter	Restrictions
Mime Type	Image JPEG